

## Low Sulphur Coal Supplies for Environmental Purposes

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As the agenda of this symposium emphasizes national concerns with regard to the adequacy of supplies of all forms of fuel, consistent with environmental requirements, it is essential that coal be placed in perspective vis-a-vis other energy sources, and with regard to the many problems associated with its availability both as a solid fuel and in converted form.

The vital role that coal must play if the Nation's energy requirements are to be met, and if a sound balance is to be achieved between indigenous and foreign sources of energy supply, is underscored by the serious need for supplemental supplies to meet the insatiable demands being made on natural gas, the decline in proved indigenous oil reserves, and increasing dependence on imported oil, with its consequent implications on national security. Equally significant is that economic, technologic, and societal problems also are delaying the availability of large-scale nuclear power availabilities.

Although environmental concerns cover a broad spectrum of considerations, anxieties with respect to the adequacy of supplies of low-sulphur coals, and of other coals for which utilization can be made viable for environmental purposes through chemical processing and other new technologies, center principally around the enormously increasing needs of electric utilities for their basic energy supplies. Closely related are the relative availabilities of the other energy sources and the extent to which low-sulfur coals are held, and used, for coke production for steelmaking both at home and abroad.

There is no question regarding the enormity of our coal resources, particularly as compared to the relatively limited resources of our other indigenous energy fuels, nor even with respect to our large reserves, per se, of low-sulphur coals. There are many problems involved in the availability of the latter, however, including their extent and location; strong deterrents to, or lack or incentives for, the development of substantially increased capacity for their production; the extent of their need in relation to potential availabilities of other energy supplies, including imports; the development of technologies to condition our high-sulphur coals to meet environmental standards; and increasingly severe sulphur content limitations which correspondingly narrow even the low-sulfur coal resource base.

Although in the interplay of economic forces coal's percentage contribution to electric power generation has declined, from 1955 to 1970 tonnages consumed increased from 141 million to 320 million tons. Notwithstanding optimism for power generation from other sources, it has been estimated that there will be a need for between 800 million and 1 billion tons of coal for electric power generation by the end of the century if the Nation's total demand is to be satisfied.

Will we be able to provide low-sulphur coal in this magnitude, or its equivalent through process technology, for power generation alone by the year 2000? And what will the availabilities be in the near-term and intermediate periods?

Environmental requirements, rules, and regulations are now! The magnitude and complexities involved are compounded by the relative suddenness with which they have been promulgated, and by their progressively severe limitations. Rather abruptly, and with little time for adjustment, we have been brought to the realization that the large reserves of our great energy resources--upon which our national strengths and social attainments were built and our expectations for the future predicated--no longer are as abundantly usable as in the past. Because of evolving social concepts our energy resource base is being sharply reduced. The name of the game today is quality, not quantity.

As patterns of control already have been set, it is essential that we have more detailed and accurate information on the extent, nature, and location of our low-sulphur coal reserves, and some indication of their relative costs to consumers. Incentives must be provided for the development of substantially increased productive capacity, and for providing the transportation facilities that will be required in the movement of these coals to markets. Also, new technologies of combustion will be required to meet differences in quality characteristics.

Whatever the reserves, the availability of mining capacity will be the major determinant of the availability of low-sulphur coal--and at the present time there are many strong deterrents to capital investments in increased capacity, especially in the East. Principal among these are uncertainties regarding the growth and timing of nuclear power generation and of utility commitments thereto, regardless of relative costs; increased oil imports; increasingly severe air pollution regulations; and some expectations that stack gas emission processes to permit the use of high-sulphur coals will obviate the need for heavy investments in new capacity for low-sulphur coal production. As a result, in recent years the great preponderance of new deep mine commercial capacity has been developed only under long term contracts. Since large underground mines are developed for a life span of 20 to 30 years, contractual assurances of continuing markets will be necessary to encourage investment of the many millions of dollars that will be required for the development of large-scale increases in capacity. Essentially, this means long term contracts with electric utilities.

Another important factor in the availability of coal is an adequate supply of transportation facilities, particularly of railroad hopper cars. As there is little or no storage at the mines, except for unit train shipments, mines generally cannot operate without an adequate supply of coal cars, which determine the number of days of active mine operation. Because of the close affinity of coal and rail transportation, the deterrents to expanded coal productive capacity also affect the development of new transportation facilities. Of considerable importance in the future will be an increase in the number of unit trains, which help to reduce transportation costs and which have contributed significantly to the shipment of low-sulphur coals from the West into Midwestern markets; and the potentials for more coal slurry pipelines and "mine-mouth" generating plants. An impressive change in energy transportation in recent years has been the increasing transmission of coal-produced power from generating plants located in or near the coalfields. Only a few thousand miles of extra-high voltage (EHV) transmission lines 10 years ago were increased to nearly 26,000 miles of lines by the end of 1970, and current construction plans call for an increase to approximately 60,000 miles within this decade.

Among the major problems of low-sulphur coal supply is the uneven distribution of reserves in relation to demand. Although major markets are in the East and Midwest, the largest reserves are in the West. Based on preliminary studies by the Bureau of Mines, it is estimated that there are 251 billion tons of low-sulphur coal reserves at less than 1,000 feet in depth, of which an estimated 198 billion tons are in the West and 53 billion tons East of the Mississippi River. Of these totals, 30 billion tons are considered to be low-sulphur strippable reserves in the West at less than 100 feet deep and 2 billion tons in the East. Preponderantly, the low-sulfur reserves are at depths which would require underground mining (168 billion tons in the West and 32 billion tons in the East). Approximately 50 percent of these quantities is recoverable in mining. Supplemental surveys and analyses are being made by the Bureau of low-sulphur coal reserves and production, separately for both the Appalachian region and the rest of the country.

The low sulphur coals of the East are located primarily in the Southern Appalachian region (mostly in West Virginia, Virginia, and eastern Kentucky, with smaller amounts in Pennsylvania, Alabama, and Tennessee). There is very little low-sulphur coal in the Midwest, which is a major area of electric power generation and other coal consumption. Even with washing, the high-sulfur coals indigenous to the Midwest generally are above the sulphur limits of air pollution regulations in most States. Under current technology only the pyritic sulphur can be removed from the coal by conventional methods. Accordingly, to conform to regulations governing coal consumption, the huge markets of the Midwest will have to rely on the Southern Appalachian and Western areas for low-sulphur coal supplies, or on indigenous or other higher-sulphur coals through the use of stack emission processes or other technological developments, including coal conversions to gaseous or liquid fuels.

In the East, most of the low sulphur coal produced customarily has been used for the production of coke for steelmaking, both at home and abroad. Primarily this is because of its high cost as compared to coals heretofore used for power generation. Much of the latter has been lower cost strip-mined coal, whereas in the low-sulphur coal areas production is preponderantly from deep mines which have higher costs and which are at longer distances from consuming markets. Also, because of quality characteristics other than sulphur content, such as differences in ash fusion, many of the coals are not usable in the combustion facilities of some utilities. Accordingly, for power generation in the East under environmental regulations there will be limited supplies of low sulphur coal for some time unless and until there is a substantial increase in mining capacity, supported by contracts with utilities.

Because of the large low-sulphur coal reserves in the West, Western coals have significant potentials for becoming major suppliers to Midwestern and other easterly markets, as well as in their own areas. As an example, owing to the use of unit trains, coal now moves from Montana into Chicago and other Midwestern areas, shipments that were unthinkable only a few years ago. Although these coals are of lesser Btu content than the low-sulphur coals of the East, they are largely strip-mined coals and are appreciably less costly to produce. In addition to unit trains there also are potentials for movement by pipeline, and for the transmission of coal-produced energy by EHV. Coal slurry pipelines have proved their practicability, the best current example being the 275-mile line from the Black Mesa coalfield in Arizona to the Mohave Power Project in Nevada. Also, there are future potentials for the transmission of synthetic coal gas into markets far distant from the coal and synthetic gas producing areas.

Just as air pollution regulations are resulting in significant shifts in consumer sources of coal supply, there also will be drastic changes in the pattern of coal production as demand shifts steadily from high-sulphur to low-sulphur coal areas--until such time as the use of high-sulphur coal becomes permissible through the use of stack emission processes or other technologies, or unless it is found that environmental standards need not be as stringent in some areas as initially considered. The interim economic and social effects on communities in high-sulphur coal areas can be drastic. Some States already require extreme reductions in the level of sulphur content over relatively short periods of time, and although other States presumably have the prerogative of determining their own requirements, they will be under the influence of rather strong Federal guidelines. The EPA recently stated that about half of the new State standards limit the sulphur content of coal to less than 0.8 percent, even though they say at the same time that not enough low-sulphur coal supply is projected to meet these requirements.

The factor of security of supply in both civilian and defense emergencies seems to be a relatively minor consideration, both in some consumer planning and environmental considerations. As costs may be a determining factor for consumers in this respect, comprehensive studies should be made of the relative costs, at points of consumption, of the respective clean energy sources.

Sample transportation studies being made by the Bureau of Mines indicate that there may be some significant price differences in favor of coal as compared to other energy sources, even in the shipment of Western coals farther eastward than Illinois.

Fundamentally, our national concerns for the environment are fully justifiable. While they should not be unnecessarily stringent, regulations should be as strong as is shown to be necessary by factual appraisal. The overall objective must be to preserve, or even improve, the environment while at the same time attaining other social goals without severe disruption to the production, distribution, and utilization of our energy resources. This requires both judgment in the determination and application of controls, and full speed ahead in the development of new technologies to bring about a favorable balance.

In summary, although it is estimated that we have large reserves of low-sulphur coals nationwide, their availability for environmental purposes is fraught with many problems. Among the most significant of these are that their location and markets are largely in contraposition; there are strongly adverse economic influences and consumer preferences, particularly in the East, that militate against the development of heavily increased productive capacity; and the extension of controls increases demand while progressively severe restrictions sharply narrow the range of availabilities as they trend toward sulphur levels that are practicably unattainable. Accordingly, it is anticipated that the supply of low-sulphur coals for environmental purposes will continue to be tight for some time to come.